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TITLE: METHOD FOR PROVIDING MULTI-PATH COMMUNICATION FOR A MOBILE VEHICLE

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METHOD FOR PROVIDING MULTI-PATH COMMUNICATION FOR A MOBILE VEHICLE

FIELD OF THE INVENTION

This invention relates generally to the communication of a mobile vehicle. In particular, this invention relates to a method for providing communication for a mobile vehicle over a multiple choice of paths.

BACKGROUND OF THE INVENTION

A rapidly increasing segment of modern vehicles, such as passenger cars, buses, trains, boats and aircraft, are being equipped with integrated wireless communications systems. Integrated wireless communications solutions enables vehicles to have embedded systems with access to mobile services, such as navigation services, cellular phone services, emergency help/assistance, traffic information, directory assistance services, Internet web access for web browsing and email, remote car diagnostics, anti-theft tracking, in-car office, and other analog or digital voice and data communications applications.

Such embedded communications devices may have multiple communications paths to select based on various conditions, such as type of service needed (analog vs. digital), communications cost (between available service providers), changing coverage areas and service providers while a vehicle is in motion, and available wireless technology in a given area (cellular phone network-based, satellite-based, radio frequency- or RF-based, etc.). However, some integrated wireless vehicle communications solutions rely solely on the ability of the integrated communication of the embedded system to establish a communications link to a wide area network (WAN).

Recent advances in wireless technologies have lead to widespread use of portable communications devices. Examples of such devices are data capable cellular phones, bi-directional (2-way) pagers and wireless portable data assistants (PDA). Such portable wireless devices could provide a supplementary wireless communications link between the vehicle and the WAN. This would be advantageous in cases where the embedded system is experiencing service interruption, or cannot provide a certain service type available to the portable device.

It would therefore be desirable to provide a method for determining the preferred communications device used to establish a communications link from the vehicle to the WAN.

SUMMARY OF THE INVENTION

One aspect of the present invention provides a method for providing multi-path wide area network access for a mobile vehicle. The primary communication device of the vehicle integrated communications system may access a wide area network (WAN). Upon initiation to the WAN, the secondary communication device availability is determined when the primary communication device queries the service provider. The service type of the secondary communication device is determined when the primary communication device queries the system. The viable battery life of the secondary communication device is determined by the power state and power life indications. The most current received signal strength indication (RSSI) of the secondary communication device is determined when the primary communication device queries the system. If a determination is made by the primary communication device that a more reliable service is available on the secondary communication device, the pending WAN connection request is initiated by the secondary communication device. The success of the WAN connection is determined when the primary communication device queries the call state of the secondary communication device.

Another aspect of the present invention provides a system for determining a multi-path wide area network access system for a vehicle. The system may include means for making an initial connection request to a WAN, means for determining the availability of the secondary communication device, means for determining the service availability and service type of the secondary communication device, means for determining the battery life viability of the secondary communication device, means for determining the most current RSSI, means for determining reliability of the available service of the secondary communication device, and means for the secondary communication device initiating a connection request to the WAN. The system may also include means for determining the success of the WAN connection based on the call state.

Another aspect of the present invention provides a computer usable medium including a computer program code for providing multi-path wide area network access for a mobile vehicle. The computer usable medium may include computer program code that determines if a secondary communication device is available, computer program code that determines service type, computer program code that determines battery life viability, computer program code that determines most relative signal strength indication, and computer program code that determines reliability of the secondary communication device. The program code may also include computer program code that initiates a service request from the secondary communication device.

The program may also include computer program code that computes a calibrated battery life threshold for determination of viable power. The program may also include computer program code that determines the battery life threshold based on the power state and/or the power life. The program may also include computer program code that computes a calibrated RSSI threshold. The program may also include computer program code that checks for received signal strength indication once the battery life exceeds the calibrated threshold.

The foregoing and other features and advantages of the invention will become further apparent from the following detailed description of the presently preferred embodiment, read in conjunction with the accompanying drawings. The detailed description and drawings are merely illustrative of the invention rather than limiting, the scope of the invention being defined by the appended claims and equivalents thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic diagram of a system for communicating from a vehicle to a service provider in accordance with the present invention;

FIG. 2 is a schematic diagram of another embodiment of a system consisting of a portable network access device linked to an embedded device of a vehicle in accordance with the present invention; and

FIG. 3 is a flow diagram of one embodiment of a method for determining a multi-path wide area network access for a vehicle in accordance with the current invention.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

FIG. 1 shows one embodiment of a system for communicating from a vehicle to a service provider in accordance with the present invention at **100**. The system **100** may include one or more vehicle clients **110**, one or more carrier systems (**115**, **120**, **125**), one or more communication networks or wide area networks (WAN) **135**, and one or more service providers **130**.

Vehicle client **110** may be any suitable vehicle. For example, the vehicle may be an automobile or a passenger carrying unit such as a bus, train, boat or aircraft. The vehicle client **110** may be an embedded device that is capable of providing remote services to the vehicle via a wireless communication link with one or more service providers **130**.

The carrier system (**115**, **120**, **125**) may be any suitable system for transmitting a signal between a vehicle and a service provider via a communications network. In one embodiment of the invention the carrier system may be a wireless carrier system **115** such as a personal communications system (PCS), a global system for mobile communication (GSM), or the like. In another embodiment of the invention, the carrier system may be a link to one or more satellites **120** that is in communication with one or more base satellite dish receivers **125**. In another embodiment of the invention, the carrier system is a link to one or more satellites **120** that relays the signal between one or more other satellites **120** before communicating with one or more base satellite dish receivers **125**. Other examples of carrier systems are radio links such as microwave, citizen's band (CB), dedicated radio systems such as police, military, or any other suitable radio communications link.

Communications network **135** may be any suitable system for communicating between vehicle client **110** or carrier systems (**115**, **120**, **125**) and a service provider **130**. In one embodiment of the invention the communications network may be a public switched telephone network (PSTN). In another embodiment of the invention, the communications network may be a multiprotocol Internet protocol (IP) network such as Internet, extranet, private network, virtual private network (VPN), or any other wide area network (WAN) capable of carrying voice and/or digital data in either digital and/or analog format. Alternately the communications network may be a hybrid or virtual communication network.

Service provider **130** may be any remote system that can provide wireless services to the vehicle client, which may include, for example, a public telephone network. In one embodiment of the invention the service provider may provide navigation services to an embedded vehicle navigation system. In another embodiment of the invention the services provider may provide emergency assistance using a system such as OnStar. Examples of remote services delivered to the vehicle are navigation services, cellular phone services, emergency help/assistance, real-time traffic information, directory assistance services, Internet web access for web browsing and email, music and video, weather and news reporting, real-time stock market updates, remote car diagnostics, anti-theft tracking, in-car office, and other analog and/or digital voice and/or data communications applications. The service provider **130** may be a single service provider or a combination of several service providers. The service provider may be capable of serving multiple vehicle clients simultaneously.

FIG. 2 shows one embodiment of a system consisting of a portable communications device (PCD) linked to an embedded device of a vehicle capable of communicating with a service provider in accordance with the present invention at **200**. The system **200** may include one or more embedded devices **205**, one or more embedded communication devices **230**, one or more controllers **210**, and one or more links **240** to one or more PCDs **245**.

Embedded device **205** may be any integrated service system in the vehicle. In one embodiment of the invention the embedded device may be a system, such as OnStar, capable of providing remote services to the vehicle, such as navigation instructions, roadside assistance, emergency assistance, and directory assistance services. The embedded device **205** may include a global positioning system (GPS) receiver capable of providing vehicle positioning information to the embedded system as well as communicating it to the service provider. In another embodiment of the invention the embedded device may be

a GPS based navigation system capable of providing visual and/or audio navigation and map services to the driver from the service provider. Other examples of such embedded devices include cellular phone systems, Internet web access for web browsing and email, audio/video systems such as broadcast and/or on-demand audio and video, text-to-speech news systems, anti-theft systems such as LoJack, remote car diagnostics systems, and integrated personal computer equipment. The embedded device may be a single system or an integration of multiple systems.

The portable communications device **245** may be a portable network access device (PNAD) capable of wireless communication via a carrier system over a communications network to a service provider. In one embodiment of the invention the PNAD may be a digital and/or analog cellular telephone. In another embodiment of the invention the PNAD may be any wireless communication device including, for example, a web-enabled personal digital assistant (PDA) such as the Palm Pilot, with wireless network access capabilities or a web-enabled wireless phone. The PNAD may be any portable device capable of communicating voice, audio, video, and/or digital data in either digital and/or analog format via a wireless carrier system over a communication network with a service provider. The PNAD may be capable of communicating with at least one embedded system via the physical and/or wireless communication link **240**.

Link **240** may be any physical or wireless communication link between the PNAD and at the embedded system in a vehicle. The link may be capable of communicating voice, audio, and/or digital data in either digital and/or analog format between the embedded device and the PNAD. The PNAD may also be capable of communicating device status information and other control information with the embedded device. Examples of device status information of the PNAD are battery life and received signal strength indication (RSSI). In one embodiment of the invention, link **240** may be a physical cable between the PNAD and the embedded device. The cable may be a cable capable of

conducting electric and/or electromagnetic signals. The cable may also be a fiber optical cable. In another embodiment of the invention, the link is a wireless communication link. The wireless communication link may communicate using radio signals and/or infra-red light, or the like.

Embedded communications device **230** may be any embedded wireless transceiver or collection of multiple transceivers such as devices **235a**, **235b**, and **235c** that are part of the embedded system capable of wireless communication via a carrier system over a communications network to a service provider. In one embodiment of the invention, the communications device is an embedded analog and/or digital cellular telephone. In another embodiment, the communications device is a satellite communications device. In another embodiment of the invention, the communications device is a RF transceiver, such as a microwave, a citizen's band (CB) radio, a dedicated radio system for police or military communications, or any other suitable radio communications link. The embedded device may be any device that is capable of communicating voice, audio, video, and/or digital data in either digital and/or analog format via a wireless carrier system over a communications network with a service provider. The embedded communications device **230** may be a hybrid of various communications devices and/or a single device capable of establishing different types of communications links, such as over a cellular telephone network and/or over a satellite radio link.

Controller **210** may be any control module or device of an embedded service system that is capable of executing program logic for determining which communications device to use in order to establish the communications link with the service provider. In one embodiment of the invention, the controller contains a central processor unit (CPU) **215** that is capable of executing a method stored in memory **220** for determining whether the communications link with the service provider should be established by a PNAD or the embedded device. The controller may be capable of querying status information such as battery life and RSSI of any PNAD linked to the system.

FIG. 3 shows a flow diagram of one embodiment of a method for achieving a multi-path wide area network (WAN) access to a vehicle in accordance with the present invention at **300**. The method illustrated in the embodiment of **300** determines if a more reliable service is available on a portable network access device (PNAD) **245** than the service provided on the embedded device **205**.

The embedded device **205** may be the system master and may handle the initiation and termination of communications sessions. The embedded device **205** may determine if more reliable service is available on the PNAD by querying the PNAD for its battery life status and its related signal strength indication (RSSI). The communications attributes of the PNAD **245** may include the type of service, the battery life, and the relative signal strength indication.

The embedded system may be capable of accessing various types of WANs, like a connection to a digital network or analog data network. Upon initiation of a WAN connection request, an embedded device **205** in a vehicle may query the system to determine if a portable network access device is available (block **305**). PNAD availability may depend on one or more PNADs currently linked to the system being activated. If the PNAD is unavailable, in one embodiment, the embedded device **205** may initiate the WAN connection request (block **350**).

The service type of the WAN connection may be determined prior to initiating the communications session, and may be analog cellular service, digital cellular service, or the like. For example, as new services such as satellite and packet data become available, the service type determination in block **310** may be modified to incorporate them. If the service type is determined to be analog or other non-preferred technology, the embedded communication device may initiate the WAN connection request (block **350**).

When the service type is determined to be digital or the preferred technology (block **310**), required battery life threshold of the PNAD **245**, which provides the service chosen in 310, may be determined (block **315**). The battery life threshold may be determined on parameters such as the power state and power life of the PNAD's power source, as well as the type and duration of the WAN connection. In block **320**, the PNAD may be queried for its battery life state. If the battery life state of the PNAD is determined to be insufficient (block **325**), the connection may be initiated by the embedded device (block **350**).

If the battery life of the PNAD is determined to be sufficient, (block **325**), the required received signal strength indication (RSSI) threshold of the PNAD may be determined (block **330**). The PNAD may be then queried for its most current RSSI (block **335**). If the most current RSSI does not exceed the required RSSI threshold for the WAN connection (block **340**), the embedded device may initiate the WAN connection request (block **350**). If the most current RSSI of the PNAD is determined to be sufficient (block **340**), the PNAD may initiate the WAN connection request (block **345**).

If the WAN connection was initiated by the PNAD (block **345**), the PNAD may be queried (block **355**) to determine if the WAN connection was successfully established. If the call state is determined to be unsuccessful by the PNAD (block **355**), the embedded device may execute a retry strategy to establish the connection, (block **360**). The retry strategy may include trying to re-establish the connection on the PNAD, or it may include initiating the request on the embedded device if the service type is available on the embedded device.

If the WAN connection was initiated by the embedded device (block **350**), the system may determine if the WAN connection was successfully established. If the call state is determined to be unsuccessful (block **355**), the embedded device may execute a retry strategy to establish the connection, (block **360**). The retry strategy may include trying to re-establish the connection on the embedded device, or it may include initiating the request on the PNAD if the service type is available on the embedded device.

If a successful WAN connection was established by the PNAD, (block **355**), both data and/or voice may be communicated via the PNAD which may then communicate with the embedded device via a two-way communications link. If a successful WAN connection was established by the embedded device (block **355**), both data and/or voice may be communicated via the embedded communication device.

While the embodiments of the invention disclosed herein are presently considered to be preferred, various changes and modifications can be made without departing from the spirit and scope of the invention. The scope of the invention is indicated in the appended claims, and all changes that come within the meaning and range of equivalents are intended to be embraced therein.